5.3.7.2 Principles from Wachusett Access Plan

The Wachusett Public Access Plan was developed to guide future MDC policy regarding public access and recreational use of its 16,000 acres of land and water resources. The access plan was completed in 1996 after more than two years of cooperative input from staff and local communities, recreationists and other open space advocates. The goal of the plan was to reduce the existing level of threats to water quality from public use of MDC Watershed lands and to provide management programs that afford long term protection of Wachusett Reservoir. Recommendations made in this plan have been developed to address specific concerns of the U.S. Environmental Protection Agency (EPA) and Massachusetts Department of Environmental Protection (DEP) that focus on the threat of *Giardia* and *Cryptosporidium* pathogens that can be introduced from human sources and the presence of domestic animals at Wachusett Reservoir. Key management recommendations included:

- Improve protection of aqueduct intakes
- Provide greater enforcement of regulations
- Provide sanitary facilities
- Improve signage
- Expand educational programs
- Foster community participation
- Improve site maintenance

5.4 Management of Biodiversity

5.4.1 Introduction

Biodiversity can be defined as the diversity of life in all its forms and at all levels of organization (Hunter 1999). This definition encourages us to look beyond simple species diversity and include genetic and ecosystem diversity as well. Setting management goals for maintaining biodiversity is inherently difficult for a variety of reasons. In most cases natural resource managers are responsible for managing biodiversity without a complete understanding of all the elements of biodiversity that may exist. For example, approximately 1.7 million species have been described globally, although estimates of the total number of species range from 10-100 million (Hunter 1999).

The most critical component to any attempt to incorporate biodiversity into management activities is the need for a large-scale perspective. Management decisions must be made with a landscape, watershed, or even a larger regional perspective. Current Division management activities incorporate a multitude of specific activities that maintain or enhance biodiversity at the micro or stand level (i.e., saving wildlife trees, buffering vernal pools, etc.). However, current Division management activities often lack the large-scale perspective that is so important to maintaining biodiversity. Hunter (1999) describes only two real goals when planning for biodiversity. They are: 1) Maintain the biodiversity of ecosystems that are in a reasonably natural condition, and 2) Restore the biodiversity of ecosystems that have been degraded.

The Division's goals for biodiversity focus on either maintaining or enhancing natural ecosystems across the watershed. The Division recognizes that its greatest contribution to regional biodiversity is protecting large areas of land from development and maintaining most of those lands in forest cover. The Division's primary management activity on these lands is creating small openings in the forest to stimulate regeneration and diversify species. These activities maintain forest cover while mimicking small-scale disturbances that occur naturally all the time. When possible and feasible, the Division will

also incorporate other management techniques to try to create or maintain a broader range of habitat conditions in order to try to provide habitat for a range of indigenous species. Creating or maintaining early successional forested and non-forested habitat is critical to a variety of species that require specific conditions that are only provided in these habitats. In addition, the Division recognizes the importance of forest reserves within the landscape for providing relatively undisturbed habitat to species dependent on conditions created by an unmanaged forest.

5.4.2 Mandate

In 1973, Congress passed the Endangered Species Act to provide federal protection for 292 declining species, and began to legally define the national commitment to maintaining biodiversity in the process. The ESA specifically protected 27 plant and animal species in Massachusetts, and provided both the impetus and funding to restore popular species such as the Peregrine Falcon and the Bald Eagle in the state. Subsequent to the passage of the ESA, Massachusetts has added additional statewide legal protection for biodiversity. Both Chapter 131 (the Wetlands Protection Act) and Chapter 132 (the Forest Cutting Practices Act) require regulatory bodies to consider impacts on habitat and species during proposed development or management activities. In 1990, Massachusetts passed its own Endangered Species Act, providing protection currently for 424 plant and animal species. This act provides regulatory protection for significant habitats of the listed species, as well as direct protection for the species.

In recent years, the protection of biodiversity has become a high priority for state agencies in Massachusetts. Massachusetts is a diverse environment that currently supports at least 15,000 visible (i.e. macroscopic) native species of plants and animals (including about 12,000 insects). MassWildlife (previously the Division of Fisheries and Wildlife) currently maintains the Natural Heritage and Endangered Species Program, the goal of which is to protect the state's native biological diversity. MassWildlife also recently launched the "Biodiversity Initiative," in order to coordinate two new programs that were created by the 1996 Open Space Bond Bill (Chapter 15, Acts of 1996). These programs include the Ecological Restoration Program and the Upland Habitat Management Program. The Ecological Restoration Program's major goal is to "focus future restoration action on the fundamental problems threatening biodiversity, including the restoration of natural processes and native community composition." To achieve this goal, the Ecological Restoration Program intends to follow the following strategies:

- Conserve species before they become rare by protecting their habitat.
- Restore natural processes that sustain biodiversity at key sites.
- Limit invasion by exotic or invasive species.
- Replicate natural processes, where they cannot be maintained or restored, at appropriate times, places, and in justifiable quantities.
- Consider species reintroduction only when species' requirements and causes of extirpation are sufficiently understood, and carefully consider the costs and benefits.

The Natural Heritage Program, in conjunction with the Massachusetts Chapter of The Nature Conservancy published "Our Irreplaceable Heritage: Protecting Biodiversity in Massachusetts" in 1998. This document outlines a Biodiversity Protection Strategy that includes the following:

- Encourage all conservation agencies, land trusts, municipalities, and not-for-profit conservation organizations to increase the importance given to and financial support for the conservation of uncommon and underprotected components of biodiversity.

- Educate landowners about maintaining and restoring certain natural processes and minimizing disturbance.
- Aid land managers in implementing land management techniques that mimic natural processes where they cannot be maintained or restored.
- Strive to achieve an equitable distribution of biologically viable conservation lands at all topographic elevations and across all ecoregions.
- Take action to conserve natural communities and species that have experienced tremendous loss or are under considerable threat.
- Focus attention on natural communities and species, common or rare that are underprotected.

The April 2000 "The State of Our Environment" from the Executive Office of Environmental Affairs (EOEA), acknowledges the link between human needs and healthy, thriving natural communities. EOEA identifies loss of habitat through development and invasive species as the two most distinct threats to maintaining natural diversity in Massachusetts, and further commits to preserving biodiversity through the identification and protection of critical habitats and the creation of bioreserves that will include central cores of public land. Specific to public forestland, EOEA has completed a Forest Vision Project that sets priorities for a biodiversity-based management approach (unpublished as of the drafting of this Plan).

MDC Division of Watershed Management mandates, stated in MGL Ch. 92, and Special Acts in the Legislature including c.372 of 1984, and c.737 of 1972, are directed at the production and protection of drinking water for metropolitan Boston. However, these laws also set forth a broad commitment to the protection of natural resources and species diversity. Chapter 737 addresses the management of Quabbin and Ware River Watersheds, and includes the following broad mandates:

Section 2: "The natural ecology of the district shall be maintained and it shall be conserved in the present degree of wilderness character...[it] shall be protected in its flora and fauna in all reasonable ways…no act shall be undertaken which will adversely affect the balance of nature…"

Section 8: "Lumbering or logging operations shall be permitted…to the extent and for the purpose of maintaining and conserving its forests in a healthful state of natural ecological balance consistent with reservoir and watershed purposes…"

As stated in Section 4.6 above, the Division's principal goals for maintaining biodiversity on its Wachusett holdings are to retain most of these lands in a forested condition, to identify and provide habitat for the protection of uncommon and rare flora and fauna, to eliminate and prevent the spread of non-native invasive species, and to provide the range of seral stages from early successional habitat through unmanaged mature forest.

5.4.3 Rare and Endangered Species

5.4.3.1 Flora

Refer to Section 2.3.3 for a description of both common and rare plant species and their habitats on the Wachusett watershed. *Isotria verticillata*, the large-whorled pogonia was the only rare plant species discovered during the 1996 survey of proposed timber-harvesting lots at Wachusett for rare species (conducted by the staff of the University of Massachusetts herbarium). MDC Foresters have also located the following state-listed species during independent surveys of Wachusett properties:

Lupinus perennis	Wild lupine	WL
Arceuthobium pusillum	Eastern dwarf mistletoe	SC
Juglans cinerea	Butternut	WL
Orontium aquaticum	Golden club	T

Although there is no current record of their presence, the species below have been predicted to occur on MDC watershed properties at Wachusett, based on past records and suitable habitats/range:

Family	Species	Common Name	Status	Flowering
Apiaceae	*Conioselium chinense*	Hemlock parsley	SC	Jul/Sep
Apiaceae	*Sanicula trifoliata*	Trefoil sanicle	WL	Jun/Oct
Asclepiadaceae	*Asclepias verticillata*	Linear-leaved milkweed	T	May/Jul
Asteraceae	*Aster radula*	Rough aster	WL	Jun/Aug
Brassicaceae	*Arabis drummondii*	Drummond's rock-cress	WL	May/Aug
Brassicaceae	*Arabis missouriensis*	Green rock-cress	T	Jul/Oct
Brassicaceae	*Cardamine bulbosa*	Spring cress	WL	Jun/Aug
Caryophyllaceae	*Stellaria borealis*	Northern stitchwort	WL	May/Aug
Cyperaceae	*Eleocharis intermedia*	Intermediate spikerush	T	Aug/Oct
Cyperaceae	*Scirpus ancistrochaetus*	Barbed-bristle bulrush	E	Jun/Jul
Gentianaceae	*Gentiana andrewsii*	Andrew's bottle gentian	T	Apr/Jun
Gentianaceae	*Gentiana linearis*	Narrow-leaved gentian	WL	Jun/Aug
Haloragaceae	*Myriophyllum alterniflorum*	Alternate leaved milfoil	T	Jun/Aug
Juncaceae	*Juncus filiformis*	Thread rush	T	Aug
Lentibulariaceae	*Utricularia minor*	Lesser bladderwort	WL	May/Nov
Liliaceae	*Smilacina trifolia*	Three-leaved Solomon	WL	Apr/Jun
Orchidaceae	*Coeloglossum viride v. bracteata*	Frog orchid	WL	May/Sep
Orchidaceae	*Corallorhiza odontorhiza*	Autumn coralroot	SC	Apr/Jul
Orchidaceae	*Cypripedium calceolus v. parviflorum*	Small yellow lady slipper	E	May/Aug
Orchidaceae	*Cypripedium calceolus v. pubescens*	Large yellow lady slipper	WL	Jun/Sep
Orchidaceae	*Isotria medeoloides*	Small-whorled pogonia	E	May/Jul
Orchidaceae	*Platanthera hookeri*	Hooker's orchid	WL	Mar/Jun
Orchidaceae	*Platanthera macrophylla*	Large leaved orchis	WL	Apr/Jul
Orchidaceae	*Platanthera. Flava var. herbiola*	Pale green orchis	T	Jun/Sep
Orchidaceae	*Triphora trianthophora*	Nodding pogonia	E	Jul/Sep
Poaceae	*Panicum philadelphicum*	Philadelphia panic grass	SC	Jul
Poaceae	*Trisetum pensylvanica*	Swamp oats	T	Aug/Oct
Poaceae	*Trisetum spicatum*	Spiked false oats	E	Jul/Sep
Ranunculaceae	*Ranunculus alleghaniensis*	Allegheny buttercup	WL	Jun/Sep
Sparganiaceae	*Sparganium angustifolium*	Narrow-leaved bur weed	WL	May/Nov
Urticaceae	*Parietaria pensylvanica*	Pellitory	WL	Aug/Sep

NOTE: For Status, E = endangered, T = threatened, SC = special concern, WL = watch list

P. Somers

Isotria medeoloides
Small-whorled pogonia

Primary responsibility in Massachusetts for the protection of endangered, threatened, or special concern plant species rests with the Natural Heritage and Endangered Species Program of MassWildlife. NHESP has identified 257 species of plants in these categories across the state, and is working continually to design protection strategies. Regulatory support for these efforts exists at both the federal and the state level. The Federal Endangered Species Act of 1973 protects 292 species of national significance, which includes the small-whorled pogonia (*Isotria medeoloides*) that is found in Massachusetts. Additional protection was provided by the 1990 Massachusetts Endangered Species Act, which protects a

total of 424 species, of which 250 are plants. The small-whorled pogonia (*Isotria medeoloides*) is perhaps the most significant rare plant that might be found at Wachusett (no current record), as it is considered endangered in Massachusetts and is also threatened nationally.

Plants are considered rare for a variety of reasons. In some cases, it is simply that Massachusetts is at the northern limit (e.g., Black maple, *Acer nigrum* or River birch, *Betula nigra*) or the southern limit (e.g., Dwarf rattlesnake plantain, *Goodyera repens* or One-flowered pyrola, *Moneses uniflora*) of their range. For species that are generally associated with the eastern deciduous forest, which dominates central and western Massachusetts, plants may be rare simply because they are poor colonizers and thus populations remain widely scattered and sparse. Loss of habitat is also a common cause of plant species loss. Bruce Sorrie, former Massachusetts state botanist, estimated that a surprising 72% of the species extirpated from the state had been lost due simply to the loss of early successional or recently disturbed habitat (Sorrie, 1989). Karen Searcy, current curator of the University of Massachusetts herbarium, reported in 1995 that 13% of the rare species likely to occur on Division properties rely on early successional habitat or disturbance such as fire to persist (Searcy, 1995). Animal populations are responsible for some losses, either through heavy browsing or through dramatic habitat alterations such as those caused by beaver. While beaver wetlands may provide habitat for some rare plants, they also flood bogs and other uncommon habitats that may have contained rare plant populations. Some species (e.g., Ginseng, *Pallax quinquefolius L.*) have declined directly because of over-collecting. Invasive, non-native plants have also been implicated in the decline of some uncommon native species (see section 5.4.5 below).

Management recommendations for protecting rare plant populations begin with efforts to identify current populations. The Division is committed to working to locate these populations and adding them to GIS databases so that they will appear on maps even at times when they are difficult to locate in the field. Several organizations, including the NHESP in Massachusetts and the Southern New England Forest Consortium, are working to develop specific management recommendations for the perpetuation of uncommon plant species. Much remains to be learned about the specific light, moisture, and regeneration requirements for the species of concern. Some species will persist best if given a wide berth, while others rely on periodic disturbance. The Division will rely on recommendations being developed to guide management practices around known and discovered rare plant populations. For instance, the Southern New England Forest Consortium has recently published "Rare and Endangered Species: Field Guide for Southern New England," which includes management recommendations. This guide recommends that managers looking to support one-flowered pyrola should "maintain a residual overstory or high basal area in forests where populations have been found" and "thin out understory vegetation." Roundleaf shadbush requires managers to "prevent woody vegetation from overtaking the site" because "this species does not like a closed forest canopy." The Division will continue to work to identify rare plant populations and to research and apply management recommendations for their protection.

5.4.3.2 Fauna

MDC property within the Wachusett watershed is home to a number of state-listed vertebrate species (Table 29). However, because the Division's land holdings are protected from development, it is possible that past rare animal surveys bypassed MDC land. It is likely that there are undiscovered populations of rare and endangered species on Division property. Although land protection is one of the most critical factors for survival, it would be very helpful to know where these species are located. The Division actively manages its landholdings, and therefore there is the potential for these activities to impact listed species. In addition, some species may require additional management in order to enhance or modify existing habitat to benefit their survival.

In order to ensure that land management activities do not disrupt or destroy listed species or their habitats, an accurate and current species occurrence database must be available and expanded. The Division biologist keeps records of listed species on MDC land that were discovered by in-house personnel or passed along by the public. The state's Natural Heritage and Endangered Species program (NHESP) has a much more complete and detailed databases of listed species. In some cases, land management activities carried out by the Division (forest cutting plan) are reviewed by NHESP. However, in other situations, routine maintenance (mowing, brush cutting) or watershed maintenance activities (road building/repair) are conducted without informing NHESP. In these situations, it is possible to unknowingly and negatively impact rare or endangered species. It would be helpful for the Division to have access to NHESP's records for planning management activities. More importantly, additional rare species surveys need to be conducted (see Section 6.3), particularly on recently acquired parcels where little is known about the land.

In many cases, rare and endangered species become rare because of loss of habitat. One of the greatest benefits of MDC land to wildlife is that it will remain in a natural state and not be developed. However, as mentioned, most of this potential land will be covered by mature forest. This is a benefit to rare or endangered species requiring forested habitat (sharp-shinned hawk, cooper's hawk, timber rattlesnake), but will not help other species that require different habitat such as fields (upland sandpiper) or early successional forest (golden-winged warbler). Approximately half the species listed in Table 29 are either dependent on wetlands or utilize them during some portion of their lives. Protecting and maintaining functioning wetland systems is a priority for the Division, which should benefit wetland species. In addition, vernal pools on Division land receive particular attention (see section 5.5.2) and protection. Further, current state CMPs for vernal pools are being studied to determine their effectiveness in protecting vernal pool dependent species.

Non-forested upland habitat is much rarer on Division property and is limited to abandoned farms and maintained open spaces. There are several species on Table 29 that require open fields or meadows. Although the Division will not create field habitat, it does recognize the importance of this habitat in the landscape. Therefore, where feasible, the Division will maintain and enhance this habitat on select portions of its land (see Section5.5.4).

Areas with highly disturbed soils represent important habitat for several species listed in Table 29. On Division land there are several large active and inactive gravel and sand pits, areas of stream and shoreline erosion, and abandoned industrial/residential land. Wood, Blanding's, and Box turtles use sandy or gravelly areas to lay their eggs. In addition, some invertebrates such as the Big Sand tiger beetle, Dune ghost tiger beetle, Oblique lined tiger beetle, Frosted elfin, and Hoary elfin utilize areas of highly disturbed soils (D.H. Small – pers.comm.). The Division recently documented wood turtles laying eggs in an abandoned Division sand pit. In many cases, however, these highly disturbed areas are scheduled for restoration (see Section 5.3.7.3). The Division recognizes the potential wildlife value some of these areas have, and in the future the Division will examine each site on a case by case basis to determine: 1) Actual erosion threat; and 2) Habitat suitability for selected wildlife species. In some cases, where erosion is not a threat, the site can be abandoned and left in its disturbed state.

Adequate habitat protection may assist some species listed in Table 29, but some still need additional assistance to successfully breed. In these cases, when personnel and resources allow, the Division may provide the added breeding structures or conditions. For example, the Division has constructed, deployed, and maintained floating cedar rafts in the reservoir, which are used by common loons for nesting. Although loons will and do nest on natural islands, the rafts provide protection from rising and falling water levels. When possible, the Division may also provide nesting boxes for Common barn and long-eared owls, and erect nesting structures for bald eagles.

TABLE 29. STATE-LISTED VERTEBRATE SPECIES WHOSE RANGES FALL WITHIN THE WACHUSETT WATERSHED, AND THEIR CURRENT STATUS ON MDC PROPERTY.

SPECIES	STATUS[1]	OCCURRENCE[2]
AMPHIBIANS		
Blue-Spotted Salamander	SC (Special Concern)	Probable
Marbled Salamander	T (Threatened)	Documented
Spring Salamander	SC	Documented
Four-Toed Salamander	SC	Probable
Eastern Spadefoot	T	Potential
REPTILES		
Spotted Turtle	SC	Documented
Wood Turtle	SC	Documented
Blanding's Turtle	T	Documented
Eastern Box Turtle	SC	Probable
Copperhead	E (Endangered)	Potential
Timber Rattlesnake	E	Potential
BIRDS[3]		
Common Loon	SC	Documented
Pied-Billed Grebe	E	Potential
American Bittern	E	Documented
Least Bittern	E	Potential
Bald Eagle	E	Probable
Northern Harrier	T	Potential
Sharp-Shinned Hawk	SC	Probable
Cooper's Hawk	SC	Probable
King Rail	T	Potential
Upland Sandpiper	E	Potential
Common Barn Owl	SC	Potential
Long-Eared Owl	SC	Probable
Short-Eared Owl	E	Potential
Sedge Wren	E	Potential
Golden-Winged Warbler	E	Potential
Vesper Sparrow	T	Probable
Grasshopper Sparrow	T	Probable
Henslow's Sparrow	E	Potential
MAMMALS		
Water Shrew	SC	Probable
Southern Bog Lemming	SC	Probable

[1] Species status in Massachusetts: SC = species documented to have suffered a decline that could threaten the species if allowed to continue unchecked; T = species likely to become endangered within the foreseeable future throughout all or a significant portion of its range; E = species in danger of extinction throughout all or a significant portion of its range.

[2] Occurrence of species on MDC land within the watershed: Documented = species actually observed; Probable = species not documented, but given available habitat, species' range, and/or observations within the watershed, they are likely to occur; Potential = species not documented, and current habitat conditions may not be suitable, but with habitat enhancement they may occur.

[3] Occurrence of birds is limited to breeding pairs, not migratory or seasonal residents.

5.4.4 Rare Natural Communities

A natural community is a combination of physical and biotic conditions that form a functionally distinct area of the landscape (Garrett et al, 2000). An area's physical conditions (e.g., topography, hydrology, geology, etc.) will determine the vegetative composition, which in turn will dictate the type of animal community that lives there. Ideally, to adequately protect and enhance these communities, all features of the system must be properly protected and enhanced, not just individual parts.

Natural communities may be rare or uncommon globally, statewide, or at a local level. To ensure all rare communities receive adequate protection it is necessary to know where the communities are located on the landscape. Unfortunately, the Division has little information regarding rare or exemplary communities within the Wachusett watershed. Some communities (e.g., vernal pools, Poutwater Pond Nature Preserve) are known and documented. However, most communities considered rare or exemplary on a local or regional level have not been mapped. The Division's first step in managing rare natural communities should be to properly classify rare, unique, and exemplary communities that may occur within the watershed. When the classification system has been established, mapping can begin to locate communities. Field inspections of mapped communities should be done to verify mapped areas. Adequate management and protection of the rare community and surrounding area should be done to try to maintain the integrity of the area.

A project to map rare, unique, and exemplary natural communities is currently being conducted on the Quabbin watershed (Garrett et al., 2000). A classification system tailored to Quabbin communities was developed and preliminary field verifications were conducted. Community mapping and management recommendations were completed in September 2000. Some information from the Quabbin study can be utilized at Wachusett. Although the community classification system was tailored to Quabbin, many of the communities are rare or unique on a statewide or regional level. For example, Talus slopes, pitch pine-scrub oak, hemlock ravines, tupelo swamps, vernal pools, and peat wetlands were identified as rare communities at Quabbin that also occur on the Wachusett watershed. Because the Division is constantly acquiring new land within the Wachusett watershed, some parcels may contain rare or exemplary communities that haven't been discovered. A complete census of Division land needs to be done to accurately inventory community types. In addition, a project similar to the Quabbin study should be conducted at Wachusett to classify rare and exemplary communities.

5.4.5 Poutwater Pond Nature Preserve

The Poutwater Pond area (Figure 9) was designated officially as a Nature Preserve in 1998, the first such designation under the Nature Preserve Act. The Nature Preserves program was created by a 1990 amendment to MGL Ch. 131, Section 10. Under the act, state lands within the jurisdiction of the Executive Office of Environmental Affairs (EOEA) may be nominated to become a Nature Preserve. Nature Preserves are intended to serve in perpetuity as examples of the state's native natural heritage. MGL Ch. 131 states that any lands, waters, or shores under EOEA control that contain rare, exemplary, or other significant natural or biological communities, or that contain significant features of native biological diversity are eligible to be considered for nature preserve status. Nature Preserves are dedicated to the public benefit for the conservation of natural communities and native species of plants and animals, and for scientific research and education. By statute, Nature Preserves are to be recognized as areas to be monitored and maintained in a natural condition. They should be used and managed in a manner consistent with protecting and perpetuating that condition.

Poutwater Pond lies in northern Worcester County in an area that is lightly developed, but where urbanization impacts are increasing. Within the Wachusett Reservoir watershed, approximately 14% of the area is in developed (residential, urban, and commercial) land uses. The Poutwater Pond bog is in the center of an expanding area of protected open space, due to recent land acquisition activity centered on the protection of the Wachusett Reservoir. Although recent development has occurred in the vicinity of Poutwater Pond, the bog sits inside a block of several thousand acres of protected land.

The classification of Poutwater Pond as a National Natural Landmark in 1972 by the National Park Service is indicative of the important regional value of this natural resource. Only sites containing excellent examples of ecological or geological features that are representative of a particular natural region are considered for this designation. Beyond this designation, Poutwater Pond is considered by the state's Natural Heritage and Endangered Species Program to be one of a small number of bogs in the state that are in relatively undisturbed condition. Poutwater Pond is situated near the geographic center of the 75,000-acre Wachusett Reservoir watershed. Within this watershed area, there are only two other northern bogs. Poutwater is the best example of a mostly undisturbed bog within the watershed. The other two bogs, both along the Stillwater River, have been recently acquired by the MDC. Both have smaller bog environments, are less diverse, and have been impacted by past development activities.

Poutwater Pond is significant for the unique geologic, hydrologic, and botanical characteristics of the site. The area designated as a Nature Preserve has a diverse surficial geological make-up that includes a kettle hole depression, organic muck soils, upland glacial till soils, and an esker. These diverse natural features and soils support an equally diverse plant community: at least 73 species of vascular plants in 34 families (Searcy 1996) representing a series of successional stages in one compact area. Poutwater Pond is classified as early-stage ombrotrophic mire, with key plants including sphagnum, ericaceous shrubs such as leatherleaf and cranberry, and coniferous tree species (larch and black spruce). Insectivorous plants occurring in the bog include pitcher plant, sundews, and bladderworts. Two plants on the state threatened and endangered species list and one on the unofficial watch-list are known to occur in the bog and adjacent wetlands. Plant communities include two forested wetland communities dominated by larch or spruce, three tall shrub wetland communities, two low shrub wetland communities, a red maple swamp forest, and upland second growth white pine, red maple, and oak forest.

The Poutwater Pond site had been in private ownership until 1994 when it was acquired for watershed protection purposes by the MDC, and had experienced relatively little impact from the visiting public. The main impacts to the site are from group visits to the bog (annual tours from local colleges and conservation organizations) and from a poorly conducted, private logging operation in the upland forest just outside of the Nature Preserve boundary. Group visits left a well-worn trail through a section of the floating mat (this trail has since been restored and upgraded). The recent logging operation caused road erosion and left logging debris in adjacent upland areas.

The Poutwater Pond Nature Preserve includes 213 acres under the care and control of MDC that encompasses the pond and the majority of its watershed, adjacent downstream wetland areas, and 11 acres under the control of DFW that encompasses an upland area that drains to the pond (Figure 9). MDC, the Mass. Division of Fisheries and Wildlife, and the Town of Holden collectively protect an extensive area surrounding the bog and wetland system (including the drainage area for the bog and pond).

Although the initial flora and fauna inventories of the Nature Preserve serve as a useful baseline, Poutwater Pond Nature Preserve has great potential for further botanical and faunal

research, as well as examination of the peat deposits in the bog as part of paleobotany studies. If managed carefully, Poutwater Nature Preserve can be an excellent educational resource for local schools, ranging from elementary to the college level. Due to the significant natural resources and excellent research and educational potential, Poutwater Pond Bog represents an excellent site for designation as the state's first Nature Preserve.

The objectives for dedicating Poutwater Pond as a Nature Preserve are:

- To protect the unique natural features included in this area as a representative of a significant habitat and natural community within the Commonwealth.
- To study the unique natural features and ecology of this area.
- To educate the public regarding these unique features, in a manner which limits public impacts to the site, and encourages an increased awareness and stewardship for the site.

The 1997 MDC Protection Plan for Poutwater Pond Nature Preserve also contains a detailed inventory of the preserve's flora and fauna as well as the cultural history and resources of the area, a description of the public uses of this area, and recommendations for controlling access, serving public education needs, and protecting the natural resources of the preserve.

FIGURE 9. POUTWATER POND NATURE PRESERVE MAP

go to www.state.ma.us/mdc/WachusettLMPfig9.pdf (file size: 1.1 MB)

5.4.6 Control of Invasive Plants

5.4.6.1 Definitions

"Invasive" plants fall into at least two categories – native or non-native species. Most of the difficulties associated with invasive plants involve plants that are non-native. This is true in part because these non-native "aliens" have been transported out of the ecosystem in which they evolved, and may have escaped specific population-controlling insects and diseases in the process. It is important to point out that not all non-native plants are invasive. Most have been intentionally introduced into agricultural or horticultural environments, and many are unable to reproduce outside of these intensively managed environments. There are, unfortunately, hundreds of others that were introduced either deliberately or accidentally to natural settings and have managed to aggressively force out native plants, raising serious biodiversity issues, and potential threats to water quality protection.

It has taken awhile for these issues to become apparent. Some of the invasive plant problems on MDC properties are the result of deliberate plantings of species that effectively addressed other concerns (for instance, planting autumn olive to improve wildlife habitat), but then became invasive. Other invasive species are escapees from landscaping that predates MDC's acquisition of reservoir properties, including Japanese barberry, Japanese knotweed, the buckthorns, and purple loosestrife. In all cases, a plant's "invasiveness" is composed of several defining qualities:

- The plant grows and matures rapidly in abundantly available habitats.
- It is capable of producing vast quantities of seed that is easily dispersed by animals, and often can also reproduce vegetatively.
- There are no diseases or pests effectively controlling its reproduction and spread (which generally means there are no close relatives in the habitats it invades).
- The plant does not require intensive management to thrive.

T. Kyker-Snowman

Invasion by Japanese barberry

5.4.6.2 Problems Associated with Invasives

The EOEA report "The State of Our Environment" (April, 2000) states that "the two biggest threats to biodiversity in Massachusetts are the destruction and fragmentation of wildlife habitats and the introduction of invasive non-native species." The Nature Conservancy has reported that 42% of the declines of threatened or endangered species in the US are partly or wholly due to the effects of invasive species. Some of these threats are subtle. For instance, when the declining West Virginia White butterfly lays its eggs on the invasive garlic mustard instead of on the usual native mustards, its eggs fail to develop. Other threats are more obvious. For instance, purple loosestrife currently covers an estimated 500,000 acres in northern US and southern Canada, displacing native food sources and threatening to prevent successful nesting in 90% of the wetlands used by breeding waterfowl along the Atlantic and Mississippi flyways. Impacts from invasives on the soil and its faunal community have also been documented. There is evidence that a Chinese tallow tree is altering nutrient cycling where it invades, causing a decline in the native soil invertebrates as a consequence.

Beyond issues of biodiversity conservation, resilient plant communities are important to watershed management for controlling the erosion of soil and nutrients throughout the range of natural disturbances (e.g., droughts, insect outbreaks, fire, wind, heavy snow and ice). Resilience is dependent upon species and size diversity in the plant community, because disturbances are frequently species and/or size specific. When plants become aggressively invasive, replacing the diverse native flora with local monocultures, they increase the susceptibility of the plant community to disturbances. The prevention of forest regeneration by certain aggressive invasives has become a problem on some areas of the watersheds. Around the Quabbin Reservoir, Japanese barberry that was planted on historic homesites has taken advantage of high deer populations (which do not feed on barberry) to colonize and monopolize the understories of significant forest areas. At the Wachusett Reservoir, autumn olive has aggressively occupied open fields, delaying or precluding their return to forest cover. Invasives are often more effective than natives in colonizing disturbed areas, and may overrun young trees that do become established. Table 30 lists the invasive plants that are present at the Wachusett Reservoir.

TABLE 30. INVASIVE PLANTS PRESENT AT WACHUSETT RESERVOIR

Common name	Latin name	Habitat
Black locust	*Robinia pseudoacacia*	Edge of forest/field
Norway maple	*Acer plantanoides*	Forest
Oriental bittersweet	*Celastrus orbiculata*	Forest
Japanese barberry	*Berberis thunbergii*	Forest
Black swallow-wort	*Cynanchum louiseae*	Open areas and edges
Shining buckthorn	*Rhamnus frangula*	Forest
Common buckthorn	*Rhamnus cathartica*	Forest
Honeysuckles	*Lonicera sp.*	Open areas
Autumn olive	*Elaeagnus umbellata*	Open areas
Russian olive	*Elaeagnus augustifolia*	Open areas
Multiflora rose	*Rosa multiflora*	Open areas and edges
Goutweed	*Aegopodium podagraria*	Floodplains, riparian areas
Japanese knotweed	*Polygonum cuspidatum*	Riverbanks, wet edges
Purple loosestrife	*Lythrum salicaria*	Wetlands
Garlic mustard	*Alliaria petiolata*	Floodplains, disturbed woodlands, roadsides
Phragmites (common reed)	*Phragmites australis*	Wetlands
Winged euonymus	*Euonymus alata*	Open woods, fields, edge

5.4.6.3 Control and Management Options

In February of 1999, President Clinton signed an Executive Order, to "prevent the introduction o invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause." This order calls for a federal Invasive Species Council that "shall recommend plans and actions at local, tribal, State, regional, and ecosystem-based levels" to address prevention and control of invasives. The first edition of a National Invasive Species Managemer Plan from this Council was to be produced by the summer of 2000. This plan may provide both additional mandate and the budget to begin to gain control over invasives.

All of the features that make a plant invasive also frustrate efforts to control and reverse its expansion. Seed production is generally prolific, and many invasives also reproduce vegetatively.

General control requires the removal or killing of mature plants, but also requires that these removals be timed in such a way that they do not result in further reproduction and spread of the plant. Controls are either mechanical or chemical. Mechanical controls include hand-pulling, girdling or mowing, mulching, tilling, and the use of heat. Chemical control is often more efficient and effective, but carries stronger risks of collateral damage to non-target species, as well as risks of water and soil contamination. Controls need to be designed around the morphology, phenology, and reproductive strategies of specific plants. For instance, while prescribed fire will reduce invasions of conifers in native grasslands, it tends to stimulate growth and reproduction of many other invaders.

The primary invasive plants found on the Wachusett watershed are listed below with recommended controls from various sources in the literature:

TABLE 31. MAJOR INVASIVE PLANTS AT WACHUSETT, AND RECOMMENDED CONTROL

Invasive Species	Recommended Control [1]
Norway maple	Cut mature trees as close to base as possible; pull seedlings/saplings including as much of the root as possible.
Oriental bittersweet	Regular mowing of edges and open areas will exclude bittersweet; triclopyr herbicides are effective as foliar or basal applications.
Buckthorns	Seedlings are easily pulled. Larger stems can be pulled or cut, and may be killed by repeated fire. Freshly cut stumps should be treated with a 50% solution of glyphosphate to prevent resprouting. As buckthorns enter dormancy later than most species, treatments should be applied mid to late autumn to reduce risk to non-target species.
Honeysuckles	Hand-pulling is effective for isolated shrubs less than 3 years old. Most effective control of larger populations occurs through cutting and basal application of 20% glyphosphate. Seeds are not long-lived, so returning to remove seedlings by hand every two years or so should eliminate the population in time. Repeated burning is only effective for a short time, as the shrubs continue to resprout indefinitely following fire.
Olives	Repeated cutting of mature stems and sprouts and pulling of new seedlings may be effective. Best control is achieved by cutting followed by either burial or herbicide treatment of cut stump.
Multiflora rose	Regular mowing, where feasible, will remove this plant. Larger shrubs should be pulled or dug out. Where mowing is not practical, cutting followed by stump treatment with glyphosphate to prevent resprouting, is effective.

[1] Control measures are from current literature and are NOT MDC/DWM policy at this time.

5.4.6.4 MDC Control Efforts During This Management Period

Treatment of invasive plants to control or reverse their spread will progress as time and budget allow, from the highest to the lower priority areas, as follows:

- Areas of invasive plants that are presenting a direct threat to existing rare or endangered plant communities. Control will be focused on area of direct threat.
- Areas where tree regeneration is critical and is being prevented by one or more invasive plant species. This may include riparian zones and other critical protection areas.

- Areas where invasive plant populations are recently established and limited in extent, so that control is a reasonable expectation.

5.4.7 Maintenance of Early Successional Habitat for Landscape Diversity

5.4.7.1 Importance of Early Successional Non-Forested Habitat

Broad changes in land use have dramatically impacted the number, type, and extent of open lands within the watershed. Early successional habitat was a major component in the landscape prior to European settlement. Evidence suggests that grasslands existed in the Northeast before Europeans arrived, and grassland birds have been a component of avian diversity for a long time (Dettmers and Rosenberg 2000). Beaver activity, wildfires, windstorms, and fires set by Native Americans generated early successional habitat. By the 1800's grasslands were even more abundant in the northeast as agricultural land dominated the landscape. Since the mid-1800's, the amount of grasslands and open fields has decreased dramatically, causing a similar decrease in many species of plants and animals that depend on open habitat. As farms were abandoned, the open fields and meadows were left undisturbed. Without frequent disturbance such as mowing, burning, or grazing, grasslands will gradually revert back to forest. Some grassland species, such as the loggerhead shrike and regal fritillary butterfly, have been extirpated from Massachusetts (Vernegaard, et al. 1998).

Recent population trends for grassland dependent species show disturbing declines. Bobolinks and grasshopper sparrows have declined 38 and 69 percent, respectively in the last 25 years (Jones and Vickery. 1998). Partners in Flight, a national conservation organization, has identified neotropical migratory bird species of concern in Massachusetts. These species have a high perceived vulnerability (they may or may not be state or federally listed) and are critical to maintaining avifauna diversity in the state. Priority species include Henslow's sparrows, upland sandpipers, grasshopper sparrows, and bobolinks. These species are all associated with grassland habitat. As farmland continues to be abandoned or converted to house lots, the amount of viable open land continues to shrink. The remaining grasslands, particularly large (>100 acres) or clustered fields, are increasingly vital to a variety of wildlife. Eastern meadowlarks, savanna sparrows, eastern bluebirds, and bobolinks use hayfields, meadows, or pastures to forage and raise young. During the fall and winter, fields provide food for migrating sparrows, warblers, larks, and snow buntings. Raptors such as northern harriers, short-eared owls, and American kestrels hunt in fields for small mammals (meadow voles, meadow jumping mice) and insects. White-tailed deer often graze in fields, and foxes will hunt fields for small mammals or rabbits. Finally, butterflies like the monarch, tiger swallowtail, and various fritillaries feed on nectar of grassland wildflowers.

The Division recognizes the regional importance of these open lands to the diversity of wildlife within the state. Division owned land within the watershed is 92 percent forested and 6 percent non-forested upland. The non-forested uplands are comprised of approximately 952 acres and includes gravel pits, administrative areas, and both active (hay only) and abandoned agricultural fields. These fields range in size from <2 acres to ~90 acres, and are distributed across the watershed. Although the Division will continue to manage a majority of its property as a multi-aged, multi-species forest, on particular areas where open habitat exists, we will manage to maintain and/or enhance these grassland communities (see Section 5.3).

5.4.7.2 Early Successional Non-Forested Habitat Management Practices

5.4.7.2.1 Field Prioritization

The Division owns a variety of open lands. In all cases, these are either open lands the Division recently acquired through its land acquisition program or has traditionally managed in an open condition. The Division will not actively create non-forested open lands that are now forested and will only continue to manage or prioritize lands that are currently non-forested. Analysis of the distribution, size, and juxtaposition of open lands within the watershed highlights the need for prioritization. Fields will be prioritized based on their size, distance to flowing water, relative isolation, and juxtaposition with other open fields (J. Scanlon. pers. comm.). In general, very small (<2 acres), isolated fields will be abandoned and allowed to naturally regenerate to forest cover. In addition, those fields (or portions of fields) that border reservoir tributaries will also be abandoned and to allow trees to grow. This will provide an adequate forest buffer around flowing streams. Larger fields (>5 acres) that are isolated will be maintained in open condition through various management practices. Large (>20 acres) fields situated near (< 1 mile) or next to other fields will be given top management priority, because these areas offer the most potential for wildlife diversity. Large clusters of open habitat may actually act as one unit, providing habitat for species (northern harrier, upland sandpiper) that require large (>100 acres) tracts of open land (Vernegaard, 1998; Sample and Mossman, 1997). These areas will be maintained or enhanced using a variety of management techniques in order to optimize the available habitat.

Following prioritization, those fields not abandoned will receive management to either maintain them in open habitat or to enhance the existing conditions. Division personnel, private farmers with lease agreements, and service contractors will complete required management activities. Grasslands used for hay will be managed differently than those fields were hay production is not occurring. In both cases, wildlife considerations will be incorporated into the proposed management activities. [See section 5.3.3. for a discussion of Agricultural Land under MDC Control]

5.4.7.2.2 Non-Agricultural Grasslands

Approximately 617 acres of MDC fields are not leased for hay production. On these fields, wildlife habitat management will be one priority. While they are not mowed yearly for hay, these fields still require active management in order to maintain them in a grassland condition. However, there are more opportunities to apply various management techniques to enhance the existing habitat. The following management guidelines for mowing on lands not used for hay production will be followed:

- Mowing should be limited to every one to three years. This will still inhibit woody vegetation and allow late-blooming wildflowers to develop.
- In years when fields are mowed, mowing should occur after August 1.
- When mowing, mower height should be a minimum of 8-10 inches off the ground to provide habitat for small mammals.
- Manage adjacent fields as one unit: Multiple contiguous fields should be managed through rotational mowing to provide a diversity of grassland types.

The Division owns several large contiguous grasslands that are potential candidates for other management activities. In addition, some smaller grasslands may also be suited to disturbances other than mowing. Burning grasslands can reduce buildup of dead vegetation, prevent the spread of woody

vegetation, release nutrients into the soil, and rejuvenate plant growth (Jones and Vickery, 1998). However, burning an area can eliminate some butterflies and moths and the newly burned area may be avoided by some bird species. Hayfields can develop a thick layer of thatch that deters some nesting grassland birds and fire is an effective way of removing this. When feasible and practical, fire management can be a benefit to grassland bird populations and other wildlife usually within a year or two of the burn. If and when the Division conducts fire management, the following guidelines will be followed.

- Burns should be conducted in early spring (mid-March to the end of April) after snowmelt but before bird nesting. Appropriate weather conditions should be considered.
- Grasslands should be burned once every 3-4 years, and if possible an unburned, adjacent field should be available for nesting birds during the burn year.
- If possible, on larger grasslands only a portion of the area should be burned in any given year. Staggering burns allows for the development and availability of a variety of habitat conditions. Not more than 30% of habitat should be burned during any year.

The quality of Division grasslands is variable. Encroaching exotic invasive plants are invading some fields. These plants typically crowd out native species and degrade the quality of the existing habitat. Most invasive plants are extremely vigorous and hardy and can be difficult to control. The Division feels it is necessary to actively try to remove and control the existence of these species in order to optimize available grassland habitat. Multiflora rose, autumn olive, honeysuckle, and buckthorns have all been found on Division grasslands. The inventory of all Division fields in 1999 found that 48% of all fields have invasive species present. [See section 5.4.6. for a discussion of the Control of Invasive Plants]

5.4.7.3 Importance of Early Successional Forested Habitat

Evidence suggests that early successional forested habitat was present in sufficient amounts and distributed well enough across the landscape to support long-term populations of early successional birds in the Northeast prior to either European or Native American intervention (Dettmers and Rosenberg 2000). Fire, major weather events, or beaver activity maintained or generated these habitats across the landscape. European and Native American populations increased the amount of early successional habitat in the region. By the mid 1800's, forest cover in New England had dropped from >90% to <50% (Dettmers and Rosenberg 2000). As farms were abandoned during the late 1800's large amounts of early successional habitat became available. Over time these large areas of early successional habitat grew beyond the early seral stages used by early successional species.

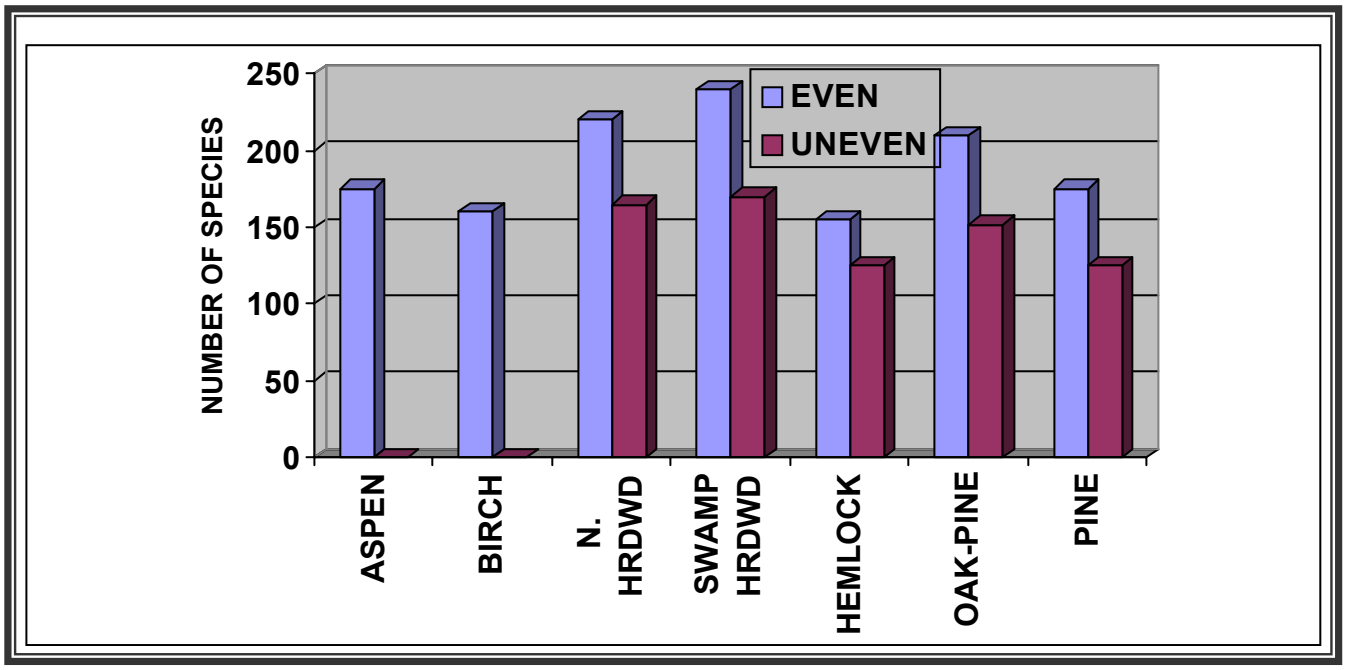
Species dependent on these early successional habitats have been declining since the 1950's as the amount of available habitat continues to shrink (Scanlon 2000). Partners in Flight species of concern list highlights species associated with early successional forested habitat (i.e. blue-winged warbler, eastern towhee, and prairie warbler). Providing habitat for early successional species involves considerations in both space and time. Early successional habitats are temporal and only support wildlife for 8-15 years. Therefore, either habitats need to be set back on a regular basis or new areas of early successional habitat need to be created.

Even-aged forest management is the primary technique used to produce early successional forest stands. This type of silviculture provides the opportunity to regenerate shade-intolerant species such as aspen and birch. The resulting habitat provides distinct foraging and shelter opportunities for species that are not usually available when uneven-aged management is used (DeGraaf et al. 1992). Even-aged management provides habitat for up to 26% more species than uneven-aged management in similar cover

types (DeGraaf et al. 1992) (Fig. 10). Failure to incorporate some even-aged management techniques within the watershed could result in fewer species. Payne and Bryant (1994) state that even-aged management tends to support more wildlife species than uneven-aged management does in northern hardwoods, hemlock, oak-pine, and pine forests of the northeast. Because the current level of tree harvesting within the state is relatively light, widely dispersed, and generally does not provide substantial early-seral habitat, the Division will try to incorporate management techniques geared towards creating this type of habitat. In the end, utilizing a range or combination of silvicultural treatments, rather than strict adherence to one, will eventually result in increased use by a wider variety of wildlife species (DeGraaf et al. 1992).

As mentioned previously, in order to provide the widest range of habitat conditions across the watershed, a variety of management techniques and applications may be needed to either create or sustain various habitat conditions. Although uneven-aged management techniques will be primarily applied across the watershed, it is important to recognize the role even-aged management plays in maintaining biodiversity. However, it is also important to realize that early successional habitat only needs to comprise a relatively small percentage of managed land in order to meet population objectives for early successional species. Limitations of resources and personnel preclude the Division from managing a large percentage of MDC land holdings in early successional stages. Therefore, for this management period, the Division's goal for early successional forested and non-forested habitat will be approximately 6-8% of MDC land. The current estimate of the amount of early successional habitat (primarily non-forested) on Division land is approximately 6%. Therefore, in order to meet management goals, some current early successional non-forested land may be abandoned, while other early successional forested areas are created.

FIGURE 10. POTENTIAL WILDLIFE SPECIES BY SILVICULTURAL SYSTEM AND COVER-TYPE GROUPS



Source: DeGraaf et al. 1992.

Even-aged: forests containing regeneration, sapling-pole, sawtimber, and large sawtimber stands in distinct units of 5 acres or more. **Unveven-aged**: essentially continuous forest canopies and intermixed size and age classes produced by single-tree selection cuttings.

5.4.7.4 Early Successional Forested Habitat Management Practices

Even-aged management is used to create early-seral forested habitats. Although "clear-cuts" are often associated with even-aged management, there are a variety of even-aged techniques that can be used to accomplish particular management goals. First, it is important to note that "clear-cut" implies that there is no regeneration in place prior to harvest. Even-aged techniques used on Division lands would always be done on stands where some regeneration was in place. Further, complete overstory removal will not be done. Typically 10-20% of the overstory will be retained in clusters of 5-10 trees scattered across the stand. An average of 2-3 clusters per acre will be retained. These occasional clumps of trees are an attempt to mimic natural disturbances. Major catastrophic events typically do not completely remove the overstory in a given area, but instead create a patchy effect on the landscape as some trees survive the event. In addition, preserving clumps of trees allows the Division to selectively save valuable mast, den, and nest trees.

In order to create conditions favorable for early successional species, forest openings need to be large enough and placed appropriately to provide enough habitat to sustain viable animal populations over time. It would be counter-productive to create early successional habitat that was too small and actually serve as a sink habitat for species. Therefore, given constraints on property size, land use, and watershed characteristics, openings on Division lands would not exceed 15 acres. Forest openings of various sizes would be carefully placed within the watershed to ensure adequate water quality protection concerns. Topography, distance to tributaries, soils, stand health, and distance to human interface would be considered when planning even-aged management. Further, when this type of management is introduced, it can provide the catalyst for further study of forest management to determine the short and long-term effects of even-aged management on nutrients and water quality parameters.

5.5 Wildlife Management

5.5.1 Assessment of Impacts of Planned Watershed Management Activities

The management activities described in this plan will have various impacts on the wildlife community at Wachusett. Most impacts on the wildlife community will be a result of habitat changes or modifications. The forest management approach described in this plan has landscape level affects, although individual changes at any given time will be very localized and small.

The amount and types of habitat at Wachusett has been dynamic since early colonial times. Once covered by primeval forest, a majority of the land in the Wachusett watershed was cleared for agriculture. This trend persisted for decades, until about 1840 when 75 percent of the arable land was in pasture or farm crops (DeGraaf et al., 1992). The next 100 years was another period of dramatic change as most of the farmland was abandoned and new forest invaded. Dramatic changes in the wildlife community accompanied these broad landscape changes. Some species thrived and expanded their range, while other were temporarily extirpated or became extinct. When agriculture dominated the landscape, species such as black bears, wild turkeys, and white-tailed deer were gone from most of their former range. Bluebirds were abundant during the agricultural period, but are now very rare breeders. Other open habitat species (bobolinks, vesper sparrows, and golden-winged warblers) are declining as well as available habitat shrinks. Today, most of the undeveloped land in the Wachusett watershed is forested. While the Division's management activities will alter habitat and wildlife species composition, probably the most significant impacts to the wildlife community have been these large regional changes in land use. In addition, recent human population expansion into the Wachusett watershed has meant the loss of more and more open space, which is converted to residential housing. Further, large-scale disturbances to the